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**The BioRegio-Contest -
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by Dirk Dohse

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# The BioRegio-Contest - a new Approach to Technology Policy and its Regional Consequences

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ABSTRACT

German technology policy has undergone a remarkable change during the last years. The first thing to mention is that technology policy in Germany takes a broader view now, focussing not only on knowledge creation (i.e. the invention process per se) but also on knowledge diffusion and faster commercialization. The second noteworthy change is the growing importance of regions as reference units for technology policy initiatives. The most prominent example is the BioRegio-contest initiated by the Federal Research Ministry in which 17 German regions compete for a given amount of public funding.The BioRegio-contest, its meaning for the German innovation system and some of its regional consequences are analyzed in this paper.

JEL classification: H11, O14, O31, R42

## *1 Introduction*

There has been a remarkable change in German technology policy during the last years. In contrast to earlier decades it takes a broader view now, focussing not so much on knowledge creation (i.e. the invention process per se) but more on knowledge diffusion and faster commercialization. The second noteworthy change is the growing importance of regions as reference units for technology policy initiatives. The most prominent example is the BioRegio-contest initiated by the Federal Research Ministry in which 17 German regions compete for a given amount of public funding. The BioRegio-contest, its meaning for the German innovation system and some of its regional consequences will be analyzed in this paper.

The paper is organized as follows: we start with some general reflections on the technology-regions connection (section 2), have a closer look at the German innovation system (section 3) and ask why biotechnology may be a peculiar technology from a regional economic point of view (section 4). Section 5 provides a detailed discussion of the BioRegio contest, section 6 gives a critical assessment and section 7 concludes.

## 2 *Technology policy and the regions*

### *2.1 The case for technology policy*

In the public debate in most industrialized countries there seems to be little doubt that there is a beneficial role for the public sector to play in subsidizing new technologies. There are some 'key' or 'generic' technologies - so the reasoning goes - that are critical to a nations' future competetiveness. These technologies - so it is further argued - are unlikely to be developed without assistance and are likely to cause gaps in a countries' technology supply chain, such that there is a need for government intervention. As a result, we observe that in many OECD countries governments devote substantial financial support to the development and deployment of so-called generic technologies.[1]

Economic reasoning throws some doubt on this popular line of argumentation. On economic efficiency grounds, a national technology policy can be justified if (and only if) private agents do not make the socially optimal decisions, i.e. if there is some kind of market failure calling for government intervention. Endogenous growth theory[2] identifies two main reasons for market failure, one focusing on positive externalities of private R&D spending, the other one on negative ones. Positive externalities cause a tendency towards private

[1] Indeed, in the case of biotechnology some observers speak of a real 'crusade'.
[2] Proponents of endogenous growth theory are - inter alia - Romer (1986, 1987, 1990), Grossman and Helpman (1990, 1991), Lucas ( 1988) and Aghion and Howitt (1992).

underinvestment in R&D since the social returns of R&D spending cannot be appropriated by private investors. Government intervention raising the level of research effort in the respective industry may then be beneficial. A national technology policy will only be successful, however, if these positive externalities (or spillovers) are geographically concentrated and thus essentially national in scope. Otherwise, i.e. if the spillovers are essentially global, national technology policy makes little economic sense because its returns (the new knowledge it helps to create) will be available worldwide without giving domestic firms a viable and persisting advantage over foreign competitors (Paqué 1996).[3] Negative externalities cause a tendency towards overinvestment in R&D due to inefficient parallel research. This points to a positive role of the government as an agent that bundles and focusses research efforts to ensure a maximum social rate of return and a minimum deadweight loss.

### 2.2 *The governance problem in technology policy and the role of the regions*

The major stumbling blocks to implementing a successful technology policy "... have to do with concrete institutional design and generating appropriate incentives for key actors" (Storper 1995: 298). This is what has been called the "governance problem" in technology policy (ibidem). Storper distinguishes three possible governance levels at which specific public goods in technology

[3] Nevertheless, it may increase the welfare of the world as a whole.

can be provided: groups of firms in *sectors*, groups of firms in *technological spaces* and *regional groups of firms*. Traditional technology policy concentrates on the sectoral or technological level whereas the regional level is excluded.

It is well known that sector or technology specific policies have often failed in the past for various reasons. A major problem of sector specific policies is that intrasectoral spillovers seem to be of less importance than intersectoral spillovers (see Glaeser et al. 1992 for empirical evidence), i.e. spillovers seem to be bound to a specific technology rather than to a specific sector of the economy. The problem with technology spaces, on the other hand, "is getting the firms in these spaces, especially when they are potential and not actual spaces, to interact sufficiently and in the right direction." (Storper 1995: 299)

Does the inclusion of the regions help to overcome these problems? Empirical evidence shows that knowledge spillovers are highly localized (Jaffe et al. 1993) This is especially true when new knowledge is not yet codified and the inter-firm exchange of knowledge occurs in an informal manner. When it is true that regions can be interpreted as learning communities that are able to internalize (at least temporarily) the positive externalities associated with the creation of new knowledge it is obvious that they should have a vital interest in strengthening their technological basis. This may explain (and partly justify) why nowadays so many state, regional and local governments engage in a competition for technology. It does not justify, however, that this process of

interregional competition should be financed, coordinated and supervised by the central government.

Is there a case for central government intervention into high tech provision at all? A possible answer is that spillovers are localized only for a certain time span and become more and more ubiquitious with increasing age of the technology such that the rest of the economy does also benefit after some periods of time. In fact, it is not just the rest of the national economy but the rest of the world economy that profits from such a public good, hence - in a first best world - a world government and not just a national government should provide it. As long as there is no such institution, however, the financing by national governments may be seen as an acceptable institutional arrangement.

There may be also a second reason for central government intervention. It is quite obvious "... that too many regions are attempting to become technology cores without even the glimmer of a possibility of so doing." (Storper 1995: 302) This means a massive waste of resources and is clearly inefficient from an overall economic point of view. So, a benevolent and omniscient central government could clearly enhance efficiency by bundling research efforts and leading the regions activities into a direction that is optimal from an overall economic point of view. In reality, however, governments are sometimes benevolent but seldom omniscient which causes practical problems. We will come back to this point later.

## 3 *The German Innovation System*

Government involvement in industrial technical change varies considerably between countries. In contrast to France and Japan where the degree of government coordination and strategic planning is fairly high, in Germany (as well as in the US and the UK) direct public involvement is relatively low. Here " .. market forces dominate, technology selection is in the hands of management, and public policies are designed to create the 'right environment' in which industry can be dynamically innovative." (Rothwell and Dodgson 1992: 225 f.)

Nevertheless, the public sector plays a prominent role within the German innovation system. According to Germany's Basic Law research promotion is a federative responsibility that is jointly exercised by the Federal and State governments. The powers of the Federal Government are primarily exercised by the Federal Ministry for Education, Science, Research and Technology (BMBF) and those of the states by their respective ministries of science or ministries of education and cultural affairs (Kantzenbach and Pfister 1996: 276).

Some figures may illustrate the importance of the public sector within the German innovation system: Of the 450.000 people engaged in R&D in Germany in 1995 almost 40% were public employees working at universities or at government institutions such as national research centers and federal research institutions (table 1).

**Table 1: R&D-Employment and R&D-expenditures in Germany (1995)**

| R&D- employment in Germany: 450000 people (= 1.5 % of total employment) | | |
|---|---|---|
| private enterprises | univer-sities | govern-ment insti-tutions |
| 60 % | 20 % | 20 % |

| Total R&D-expenditures in Germany: 81 billion DM (= 2.4 % of GDP) | | |
|---|---|---|
| private sector | government sector | |
| (60 %) | (40 %) | |
| | federal level (2/3) | state level (1/3) |

Source: Klodt 1996

Total expenditures on R&D amounted to 81 billion DM in 1995, which is equivalent to 2.4 percent of German GDP. About 40% of this amount are financed by government institutions. Two thirds of these public funds are spent at the federal level and one third at the state level. However, note that R&D funds of states are for the largest part concentrated on university research

mainly supporting science and not technology (Klodt 1996: 14). The major part of federal funds (about 65 percent) is spent by the Federal Research Minsistry (BMBF). Other main contributors are the Ministry of Defence and the Ministry of Economics.

Federal funds flowing to public and private non-profit research institutions are usually granted as institutional support that constitutes the financial basis of these institutions and is not bound to specific research projects. A similiar amount is spent on project support of which two thirds are paid to private sector enterprises and the remaining third to public and private non-profit institutions. Public project support to the private enterprise sector is highly selective: The bulk of public funds (almost 50%) flows to the aircraft and space industry whereas other major R&D performers such as electrical and non-electrical machinery or chemicals have only limited access to public funds (Klodt 1996: 16 f.). Outside the aircraft and space industry, Germany has so far largely abstained from sector specific policies targeting at 'generic' high tech industries. This has led some observers to criticize that " R&D support in Germany appears to be structurally conservative rather than structurally formative" (Koopmann et al. 1997: 76).

The BioRegio-contest marks a major shift in German technology policy not only because it reflects the will to catch up in a 'strategic' high tech industry but also because it addresses the regions as relevant players in this process and

stimulates interregional competition. Before we analyze the BioRegio contest in more detail it seems worth while to ask why biotechnology may be a peculiar technology from a regional economic point of view.

## 4. *Biotechnology and Space*

### *4.1 Characteristics of the biotechnology industry*

Biotechnology differs fundamentally from other industrial technologies in at least three respects (Eliasson and Eliasson 1996):

- it originated in academia and comes quite close to the ideal picture of a science based industry;
- the main cost factors are laboratory work and marketing, the actual manufacturing cost of a drug being relatively small;
- innovations and industrial applications predominantly occur in regional clusters or competence blocs.

The globally dominant US biotech industry clusters around a few advanced university centers, namely the San Diego, the San Francisco Bay and the Boston-Cambridge-Worchester areas. Over one third of the industry is concentrated in California[4], another 15 percent of all US biotech firms are

[4] If California were a seperate country it would tie with Japan in both biotech science and industry (Zucker et al. 1998: 68).

located in Massachusetts and New Jersey (Ernst and Young 1998a: 45). Table 2 gives some stylized facts about the economic situation of the US biotech industry. The most striking aspects are that the biotech industry is rapidly growing (in terms of employment, revenues and investment), but is still in deficit (and highly dependent on government funds) and, furthermore, that there seems to be a process of firm concentration under way.

**Table 2: US- Biotechnology Industry Statistics**

| | *1996* | *1995* | *Percentage Growth* |
|---|---|---|---|
| *Number of Companies* | 1.287 | 1.308 | -2% |
| *Number of Employees* | 118.000 | 108.000 | 9% |
| *R&D Expenses*[a] | 7.9 | 7.7 | 3% |
| *Sales*[a] | 10.8 | 9.3 | 16% |
| *Revenues*[a] | 14.6 | 12.7 | 15% |
| *Market Capitalization*[a] *(money invested in US biotech industry)* | 83.0 | 52.0 | 60% |
| *Net Loss*[a] | 4.5 | 4.6 | -2% |

[a] in billion $

Source: BIO 1998

Compared to the US biotech industry, the *European* biotech industry for a long time played only a minor role on the world market. In recent years, however, the gap has become smaller since the European biotech sector has been growing more rapidly. The two leading countries in European biotech are the UK and Germany. The UK is the home of Europe's most active entrepeneurial bioscience sector, having more start up companies than any other European country and attracting the most funding." (Ernst and Young 1998: 68) Germany missed the dynamic development of the industry in the early 90's but started to catch up in the mid-90's: In 1995 there were only 75 biotech firms in Germany, about two years later there are almost 300 of them (BMBF 1997). Similar to the situation in the US, European biotech industry shows a strong tendency towards clustering, the most important cluster being the Cambridge-London-Oxford triangle. Other important biotech clusters in Europe are Paris (Ile-de-France), the Rhine-Neckar triangle (Heidelberg, Mannheim, Ludwigshafen), Munich, Berlin, Amsterdam, Glasgow and the Kobenhaven/Malmo area. By contrast, southern and eastern Europe until recently have been virtually ignored by those associated with biotech company formation (Ernst and Young 1998b: 73).

### *4.2 Why do biotech firms cluster?*

Since the seminal work by Marshall (1920) it is usual to distinguish three sources of agglomeration economies that may explain why firms tend to cluster: labour market pooling, specialized inputs and knowledge spillovers.

Labour market pooling in the context of biotechnolgy means the availability of scientific expertise in disciplines such as microbiology, biochemistry, biochemical engineering and genetics as well as of management, marketing and financing skills necessary to start companies (Prevezer 1997: 258). Specialized inputs for (early stage) biotech industry are reagents as chemical percursors, biosensors, separation and purification equipment, testing devices and a whole range of bioprocessing equipment for scale-up and manufacture (ibidem).

Knowledge spillovers - although generally regarded as most important agglomeration factors - are harder to trace as noted by Krugman 1991. One may ask why spatial proximity plays such an important role for spillovers to occur. Obviously, the costs of information transfer over large distances have been rapidly decreasing during the last decades. So, at first glance, in the age of Internet, fax and E-mail spatial aspects may seem of ever decreasing influence. Such an assessment is, however, premature. There are good reasons to assume that spatial proximity encourages the creation and diffusion of knowledge such that knowledge can be viewed as a special kind of a local public good: Recent empirical studies have shown that knowledge spillovers are geographically

localized (Jaffe et al. (1993), Glaeser et al.(1992), Audretsch and Feldman (1996)). This may be due to the fact that new knowlege is often unstructured and highly complex (tacit knowledge) and can thus best be transferred face to face (see Polanyi 1958). Furthermore, new knowledge is often produced cooperatively in joint ventures or innovation networks. In these cases the advantage of spatial proximity is not so much the reduction of information costs but the fact that only close personal relationships allow for the evolution of incentive and sanction mechanisms necessary for the keeping of the implicit cooperation contracts (Bröcker 1995).

Is biotechnology a peculiar industry in this respect? Do the spatial implications of biotechnology differ systematically from those of other industries? The empirical literature suggests that three aspects deserve special importance:

- For a knowledge-based industry like biotechnology knowledge-spillovers play a much greater role than for less knowledge-intensive industries (Audretsch and Feldman 1996). This may - at least partly - explain that the prospensity to cluster is extraordinarily high in biotechnology.
- The breakthrough discoveries involved in modern biotechnology have fundamentally changed the way how subsequent bioresearch was done. Thus, the fruits of the biotechnological revolution are quite well

appropriable by the star scientists who achieved these breakthroughs: They typically work with or create firms within commuting distance of home or university and thus create locational effects of university research (Zucker et al. (1998)).

- The importance of spatial proximity varies with the role played by the scientist: Proximity matters more in the case of founders than for members of scientific advisory boards and it also matters more the less formal and institutionalized the links between researchers and companies are (Audretsch and Stephan (1996)).

One should, however, keep in mind that biotechnology is not a homogenous block but is composed of different subsectors. Prevezer (1997) has found that there is a positive attraction and feedback between a group of sectors in the biotechnology industry - namely the therapeutics, diagnostics and the equipment/research tools sector - whilst in other subsectors such as chemicals, food and to some extent agriculure there is much less attraction and interaction between them.

## 5 *The contest*

Compared to other countries, biotechnology had a slow start in risk averse Germany although Germany traditionally has a strong basis in chemical

industry. Therefore, the BioRegio-contest was designed to work as the motor of the catch up process, stimulating biotech firm start ups, the growth of existing companies and the provision of venture capital. The ambitious aim is to make Germany the number 1 in European biotechnology until the turn of the century (BMBF 1997).

The rules of the contest are rather simple: All regions wishing to participate have to give a presentation of their respective strengths in biotech from the lab bench to the market as well as proposals for future development of biotechnology in the region. An independent jury is installed to find the three best organised regions with the most promising development concepts. The winning entries each receive up to DM 50 million of public funding to invest in biotechnology. From a regional economic point of view it is especially interesting:

- how the BioRegios formed
- by which criteria the performance and the development concepts of the BioRegios were compared and evaluated and
- which regions got the subsidies.

### *5.1 What is a BioRegio?*

The participants in the contest are very heterogeneous regions (table 3 and map 1). Some of them are single cities (and their hinterland) such as Freiburg (3), Jena (6) or Regensburg (No. 12 in map 1). Others are networks of neighbouring cities such as Braunschweig-Göttingen-Hannover (9) or Heidelberg-Ludwigshafen-Mannheim (15) or they cover whole federal states such as BioTOP-Berlin-Brandenburg (1).

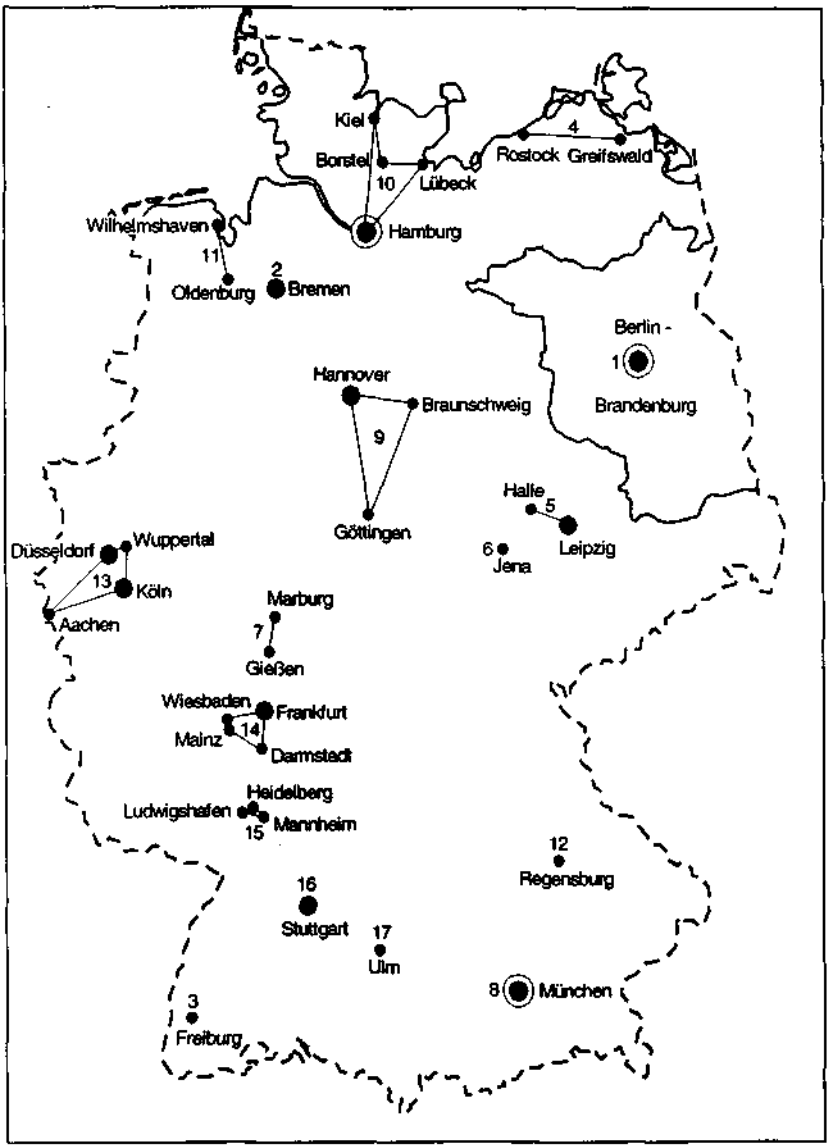
Some of these regions are situated in the industrial cores of Germany (e.g. the BioRegio Rhein/Main with Wiesbaden, Mainz, Frankfurt and Darmstadt and the BioRegio Rhein-Neckar-Dreieck with Heidelberg, Ludwigshafen and Mannheim) whereas others (e.g. Greifswald-Rostock) are peripheral regions. The most populous region (Berlin-Brandenburg) has more than six million inhabitants, compared to just a little more than onehundret thousand in the smallest BioRegio (Jena).

**Table 3: Participants in the BioRegio-contest**

| No. in map 1 | Name of BioRegio | Cities or states involved (million inhabitants) | selected as model region |
|---|---|---|---|
| 1 | BioTOP-Initiative Berlin-Brandenburg | Berlin (3.471)<br>State of Brandenburg (2.542) | - |
| 2 | Region Bremen | Bremen (0.549) | - |
| 3 | BioRegio Freiburg | Freiburg (0.199) | - |
| 4 | BioRegio Greifswald-Rostock | Greifswald (0.061)<br>Rostock (0.227) | - |
| 5 | BioRegion Halle-Leipzig | Halle (0.282)<br>Leipzig (0,470) | - |
| 6 | BioRegio Jena | Jena (0,101) | (yes)[a] |
| 7 | BioMIT Mittelhessen | Gießen (0,073)<br>Marburg (0,076) | - |
| 8 | Initiativkreis Biotechnologie München | Munich (1,236) | yes |
| 9 | BioRegioN | Braunschweig (0,252)<br>Göttingen (0,126) Hannover (0,523) | - |
| 10 | Bioinitiative Nord | Hamburg (1,707) Kiel (0,246)<br>Lübeck (0,217) Borstel (< 0,010) | - |
| 11 | Region Nordwestliches Niedersachsen | Wilhelmshaven (0,090)<br>Oldenburg (0,151) | - |
| 12 | BioRegio Regensburg | Regensburg (0,125) | - |
| 13 | BioRegio Rheinland | Köln (0,965) Düsseldorf (0,571)<br>Wuppertal (0,381) Aachen (0,248) | yes |
| 14 | BioRegio Rhein-Main | Wiesbaden (0,267) Mainz (0,183)<br>Frankfurt (0,650) Darmstadt (0,139) | - |
| 15 | BioRegion Rhein-Neckar-Dreieck | Heidelberg (0,138) Ludwigshafen (0,167) Mannheim (0,311) | yes |
| 16 | BioRegion | Stuttgart (0,585) | - |
| 17 | BioTechnologie Ulm | Ulm (0,115) | - |

[a] Special vote

## Map 1: The German Biotech Landscape



### 5.2 *Evaluation criteria and winning regions*

To evaluate and compare the development concept and performance of the 17 BioRegios an independent jury consisting of scientists, industry and trade union representatives was installed by the Federal Research Ministry. The jury picked out three model regions on the basis of the following criteria (table 4):

**Table 4: Criteria by which the 'model regions' were picked out**

| |
|---|
| – Number, profile and productivity of biotech research facilities and universities in the region |
| – Communication facilities of biotechnology research organizations in the region |
| – Existing companies oriented towards biotechnology in the region |
| – Supporting service facilities such as patent office, information networks, consulting support from public authorities and banks |
| – Strategies to convert biotechnology know-how into new products, processes and service, including marketing strategies |
| – A concept to help the start-up of biotechnology-based companies |
| – Provision of resources through banks and public equity to finance biotechnology companies |
| – Cooperation among regional biotech research institutes and clinical hospitals in the region |
| – Local authorities approval practice with regard to new biotech facilities and field experiments |

Source: BMBF 1996

The three regions selected by the jury were Munich, Rhineland (including the cities of Cologne, Düsseldorf, Wuppertal and Aachen) and the Rhine-Neckar Triangle (Rhein-Neckar-Dreieck) with Heidelberg, Mannheim and Ludwigshafen. It was pointed out that these regions all have a comprehensive scientific basis in modern biotech research, substantial enterpreneurial activity in the field of biotechnology and a promising regional development concept for biotech industry. The three winning regions receive priority in the appropriation of funds from the "Biotechnology 2000"-program of the Federal Research Ministry. Funds amounting to 150 million DM are reserved for them.

The East German region of Jena received a 'special vote' for its 'especially positive new-orientation' in the field of biotechnology after re-unification and was granted public funds amounting to 5.7 million DM until August 1997 (BMBF 1997).

### *5.3 Some interim results and trends*

It is clearly too early to draw final conclusions, however, we may report some provisional results and trends here. The Federal Research Ministry argues that the Bioregio-contest has stimulated a rapid growth of the biotech sector in Germany (BMBF 1997):

- Within the 17 BioRegios there has been an all time high of 93 biotech firm start ups between mid 96 and mid 97.
- The venture capital market for biotechnology in Germany is booming: Private venture capital amounting to 565 million DM is available for activities related to the Bioregio-contest.
- The labour market effects are positive but not overwhelming: According to the BMBF each new firm creates six additional jobs on average.

It is practically impossible, however, to decide how much of this positive development is due to the Bioregio-contest and whether its long run benefits will exceed its costs. We turn to some more general deliberations now.

## *6 Critical assessment of the BioRegio-contest*

The critical question in assessing the BioRegio-contest is whether it provides the right incentives and contributes to increasing the efficiency of the German innovation system. Ergas (1987) in his insightful paper has suggested three criteria for the implementation of succesful technology policy initiatives:

- the easing of constraints and rigidities which slow the diffusion of new skills and technical capabilities,
- the improvement of the human capital base and
- increasing the extent to which technology policy relies on market signals and incentives, rather than on the administrative allocation of resources.

Surely, the Federal Research Ministry had something like that in mind when it initiated the contest. But did it really succeed? We will look at the advantages and the problems of this particular method to allocate public funds for subsidizing biotechnology.

### *6.1 Advantages*

The BioRegio-contest is remarkable in at least two respects: The first aspect is that a mission-oriented policy is pursued by competitive means and not by centrally planned objectives. This is quite atypical since the dominant feature of mission-oriented technology policy is concentration, i.e. mission-oriented programs typically concentrate decision, implementation and evaluation (Ergas 1987: 16f.). The BioRegio-contest combines centralized and decentralized features, i.e. centralized choice of technology and centralized evaluation go hand-in hand with a decentralized implementation strategy which contributes to

avoiding part of the well-known efficiency problems of a purely centralized policy.

The second remarkable aspect is that the competitors are not individual firms but whole regions. Such an approach is innovative as it creates incentives for the regional actors (firms, research institutes, banks, politicians and public administration) to focus the technological potential of their respective regions and to prepare actively for the era of intensified interregional competition brought about by progressive globalization and European integration.[5] As it becomes increasingly clear that national governments lose influence and cannot shelter their respective regions from increasing competitive pressures, giving them a competitive edge in an emerging technology may be seen as an attractive stategy of providence for the future. Furthermore, it is in line with the claim that technology policy should give more attention to the regions as spillovers most often occur at the regional level. Thereby it addressess the governance problem in a more convincing way than traditional technology policy.

### *6.2 Problems*

There are, however, critical features remaining. They relate to the way the winners were picked out, the possible trade offs between the goals of

[5] Moreover, it stimulates private public partnership within the respective regions.

technology policy and regional development policy and to the possible distortions caused by such a policy.

The criteria used by the jury seem to be quite ad hoc, the implicit weighting scheme was not made explicit. The result of the contest is not very surprising. The three winning regions (Munich, Rhineland and the Rhine-Neckar-Triangle) are all located in the industrial cores of Germany and accomodate some of the worlds leading life sciences and chemical enterprises. The Rhine-Neckar-Triangle has BASF, Boehringer Mannheim and E. Merck nearby. BioRegio Rhineland is home to the multinational Bayer AG. Initiativkreis Biotechnologie München also includes Boehringer Mannheim and has within its boundaries many of Germany's new entrepreneurial biotech companies (Ernst and Young 1998b: 70). One may therefore ask whether it makes sense to give sugar to the top performers as they would probably make headway without subsidization by the government. There is also a clear trade off between such a kind of technology policy and regional development policy which aims at strenthening the less favoured regions. An obvious alternative, therefore, would be the subsidization of lagging regions. The problem here is that the critical mass of technological competence is often not reached such that taxpayers money is wasted - a classical dilemma of innovation-oriented regional development policy. Instead, one could deliberate to subsidize the *second best performers* who could get to the top with these subsidies. This may help to create a greater

number of leading regions, which in turn may stimulate interregional competition not just for public funding but for the development of new ideas, new products and higher income.

In section II we concluded that on theoretical grounds there may be good reasons for the central government to finance, coordinate and supervise the process of interregional competition for technology: A benevolent and omniscient central government could enhance efficiency by bundling research efforts and leading the regions activities into a direction that is optimal from an overall economic point of view. However, even if bureaucrats were benevolent the problem remains that they are not omniscient. Central government intervention may be costly (apart from its direct costs in the form of taxpayers money) as it fosters the development of some selected regions and suppresses the development of other regions (at least in relative terms) without being able to prove that the planned development is - in the long run - superior to the spontaneous (and sometimes chatoic) development brought about by the market forces. So, the market-compatibility of such a policy seems still ambiguous: On the one hand, the BioRegio-contest recognizes and tries to exploit the superior efficiency of competitive markets by (partly) simulating market processes and stimulating competitive behavior. On the other hand, it reveals a fundamental distrust of market results as the final filter when it comes to decide where to

invest and what regions take the lead is not the market but what bureaucrats think is good for the countries' long run competitiveness.

### *6.3 A model for other countries?*

Apart from the problems discussed in subsection 6.2 there may be other reasons for not transforming the concept of the BioRegio-contest to other countries. As is well known, the effect of technology policy strongly depends on the environment in which it operates. The German innovation system displays a clear bias in favour of existing industries and incremental rather than radical innovation. Therefore, Germany may be characterized as "a paradigmatic case of deepening" (Ergas 1987). This bias is a matter of concern for German policy makers who fear that Germany could lose its competence in high tech industries and - in the longer run - its competetiveness on the world markets. By contrast, the innovation systems of countries like the US, the UK or France are characterized by "shifting" (towards new technologies) rather than "deepening" (of existing technologies) such that there is less need for government intervention in support of new technologies in these countries. To put it the other way round, there may be some scope for "shifting" in German technology policy that can be brought about by such instruments as the BioRegio-contest.

On the other hand, a positive contribution of "shifting" to overall growth is most likely in an environment characterized by a high mobility of human capital, technical, managerial and financial resources that accelerates the diffusion of new skills and technical capabilities. Such a high degree of mobility is a structural feature of the US economy but it is lacking in most European countries (including Germany) which raises the question if "technology shifting" - as intended by the BioRegio-contest - is an approriate strategy for the European countries at all.

## 7 *Conclusions*

The BioRegio-contest marks a major shift in German technology policy not only because it reflects the will to catch up in a 'strategic' high tech industry but also because it builds upon the crucial role of the regions as relevant players in this process and stimulates interregional competition. It is the first time - as far as we know - that a national government tries to systematically exploit the technology-regions connection for competitiveness policy purposes.

Such an approach has advantages - especially with respect to handling the governance problem - as well as risks since it cannot resolve the fundamental information problem that makes central government intervention a risky (and sometimes rather distortionary) business.

Whether the BioRegio-contest will be a long run success or just a waste of money is hard to predict. However, a credible and responsible technology policy must be ready to undergo an ex post control after some five to ten years proving that its social return on investment can compete with the return of alternative assets. Only if the results of such a comparison are satisfactory the BioRegio-contest can serve as a model for other countries.

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